

## SECTION 16110

### RACEWAYS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. All wiring shall be installed in continuous raceways as specified herein except where specifically noted otherwise.
  - 1. When in conformance with the National Electrical Code and other applicable codes and listed for use in return air plenums, low voltage wiring (30-volt or less) may be installed without conduit above accessible ceilings unless noted otherwise. All low voltage wiring at other locations (concealed in walls, above non-accessible ceilings, exposed areas without ceilings, etc.) shall be installed in conduit. All fire alarm system wiring shall be installed in conduit. All cable installed without conduit shall be neatly placed within joist space above ceilings and properly supported. Cable shall not be placed on or supported by ceiling system.
- B. Types of raceways in this section include the following:
  - 1. Electrical metallic tubing.
  - 2. Liquid-tight flexible metal conduit.
  - 3. Rigid metal conduit.

#### PART 2 - PRODUCTS

##### 2.1 METAL CONDUIT AND TUBING

- A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements and comply with applicable portions of NEC for raceways.
- B. Rigid Steel Conduit: Provide rigid steel, zinc-coated, threaded type conforming to ANSI C80.1 and UL 6. Provide zinc coating fused to inside and outside walls.
  - 1. Rigid Metal Conduit Fittings: Rigid metal conduits shall have threaded couplings when installed in concrete or direct burial in the ground. Other installations in dry locations may be threadless rigid fittings.
- C. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit conforming to UL 360; construct of single strip, flexible, continuous, interlocked and double-wrapped steel; galvanized inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC).
  - 1. Liquid-Tight Flexible Metal Conduit Fittings: Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated throat.
- D. Electrical Metallic Tubing (EMT): Provide electrical metallic tubing conforming to ANSI C80.3 and UL 797.

1. EMT Fittings: Fittings for EMT shall be steel and may be of the screw or compression type except that in poured concrete the screw type is not acceptable. All EMT connectors shall be of the insulated throat type. Cast or indenter fittings are not acceptable. EMT connectors shall be fastened to box or enclosure with locknuts. Snap-in fittings are not acceptable.
  2. Steel EMT connectors with male threads on the locknut and female threads on the connector equal to Cooper Crouse-Hinds Space-Saver connectors may be used in lieu of insulated throat type connectors.
- E. Conduit Bodies: Provide galvanized cast-metal conduit bodies of types, shapes and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded-conduit-entrance ends, removable covers, either cast or of galvanized steel and corrosion-resistant screws.

## 2.2 WIREWAYS

- A. General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps and other components and accessories as required for complete system.
- B. Lay-in Wireways: Construct lay-in wireways with hinged covers, in accordance with UL 870 and with components UL Listed, including lengths, connectors and fittings. Select units to allow fastening hinged cover closed without use of parts other than standard lengths, fittings and connectors. Construct units to be capable of sealing cover in closed position with sealing wire. Provide wireways with knockouts.
1. Connectors: Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached that removal is not necessary to utilize the lay-in feature.
  2. Finish: Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Plate finish hardware to prevent corrosion. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.
- C. J.I.C. Wireway: Construct wireway in accordance with UL 870. Manufacture to J.I.C. Standards for Oiltight and Dusttight Lay-in Wireway and to NMTBA Standards for Industrial Control Equipment.
1. Lengths and Fittings: Manufacture from 14-gage steel, provide straight lengths with hinged covers with gasketing. Hold covers closed with external latches. Installation of Knockouts in either lengths or fittings are to be avoided.
  2. Connections: Provide wireway that is suitable for "lay-in" conductors and with joint hardware assembly with each piece. Provide gasketed joint assembly, attached in such a manner that it does not have to be removed to utilize the lay-in feature.
  3. Finish: Provide sheet metal parts with corrosion resistant phosphate coating and baked enamel finish.
  4. Installation: Fasten wireway joint connections with use of slotted hex head screws. Gasket each joint for oil-tight seal where lengths are joined.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF RACEWAYS

- A. General: Install raceways as indicated; in accordance with manufacturer's written installation instructions, and in compliance with NEC and NECA's "Standards of Installation". Install units plumb and level and maintain manufacturer's recommended clearances.
- B. Coordinate with other work including wires/cables, boxes and panel work, as necessary to interface installation of electrical raceways and components with other work.

### 3.2 INSTALLATION OF CONDUITS

- A. General: All conduits shall be concealed unless noted otherwise. Install concealed conduits either in walls, slabs or above hung ceilings. In existing work where conduits can not be concealed in finished areas, surface metal raceways shall be used.
  - 1. Mechanically fasten together metal conduits, enclosures, and raceways for conductors to form continuous electrical conductor. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly.
  - 2. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.
  - 3. Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install expansion fittings in raceways every 200-feet linear run or wherever structural expansion joints are crossed.
  - 4. Use roughing-in dimensions of electrically operated unit furnished by supplier. Set conduit and boxes for connection to units only after receiving review of dimensions and after checking location with other trades.
- B. Conduit Installation: Provide rigid conduit where embedded in concrete on or below grade, in direct contact with earth or fill below slab, wet locations, in sizes larger than 2-inches or installed outdoors. Follow minimum requirements in other areas as follows:
  - 1. Use rigid steel zinc-coated conduit in spaces where exposed below 4-feet-0-inch height in Mechanical Equipment Rooms, Electrical Equipment Rooms, Penthouses and in service splines. Other areas include warehouse spaces where exposed below 18-feet-0-inch height, on floors of crawl spaces and locations subject to mechanical injury.
  - 2. Where acceptable to all authorities having jurisdiction, intermediate metal conduit may be used in lieu of rigid steel conduit in non-hazardous locations when in compliance with NEC.
  - 3. Use PVC coated rigid steel conduit and fittings where installed in corrosive atmosphere. Patch all nicks and scrapes in PVC coating after installing conduit.
  - 4. Use steel zinc-coated EMT for raceway systems except as specifically specified previously, where not allowed by NEC or noted on drawings. Additionally EMT shall not be acceptable below grade, in or under slabs on grade, in wet locations or in sizes larger than 2-inches.

5. Use flexible conduit in movable partitions and from outlet boxes to recessed lighting fixtures in accessible ceilings, and final 24-inches of connection to motors, or control items subject to movement or vibration, and in cells of precast concrete panels. The maximum length for flexible conduit shall not exceed 6-feet.
6. Use liquid-tight flexible conduit where subjected to one (1) or more of the following conditions:
  - a. Exterior location.
  - b. Moist or humid atmosphere where condensate can be expected to accumulate.
  - c. Pump motors.
  - d. Corrosive atmosphere.
  - e. Subjected to water spray or dripping oil, water or grease.
7. Rigid Non-Metallic Conduits:
  - a. Rigid non-metallic conduits may be used below grade or embedded in concrete on or below grade only.
  - b. Rigid non-metallic conduits shall not be used for exposed stub-ups above floor. Where acceptable to authority having jurisdiction, rigid non-metallic conduits may be stubbed-up 6-inches above floor where concealed within walls. In masonry walls, non-metallic conduits may be extended to a maximum of 48-inches above floor.
  - c. Make solvent cemented joints in accordance with recommendations of manufacturer.
  - d. Install rigid non-metallic conduits in compliance with NEC, local utility practices, and all other authorities having jurisdiction.
- C. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling thread inside the plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6-inches above the floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor.
- D. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- E. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200 lb tensile strength. Leave not less than 12-inches of slack at each end of the pull wire.
- F. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean. Use temporary closures to prevent foreign matter from entering raceways.
- G. Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.
- H. Size conduits to meet NEC requirements and as shown on drawings or specified herein. All conduits shall be 3/4-inch minimum trade size.

- I. Fasten rigid conduit terminations in sheet metal enclosures with locknuts inside and outside enclosure or with threadless rigid box connectors and terminate with bushing.
- J. Conduit terminations in wet locations shall be of the threaded hub type or other sealing type fittings UL Listed for use in wet locations.
- K. Conduits are not to cross vertical or horizontal openings such as pipe shafts, elevator shafts, ventilating duct openings, etc.
- L. Keep conduits a minimum distance of 6-inches from parallel runs of flues, hot water pipes or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.
- M. Conduit shall be properly supported as specified herein and as required by NEC.
- N. Support riser conduit at each floor level with clamp hangers.
- O. Use of running threads at conduit joints and terminations is prohibited. Where required, use 3-piece union or split coupling.
- P. Complete installation of electrical raceways before starting installation of cables/wires within raceways.
- Q. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL Listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:
  - 1. Where conduits enter or leave hazardous locations.
  - 2. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.
  - 3. Where required by the NEC.
- R. Openings around electrical penetrations through fire-resistant-rated walls, partitions, floors or ceilings shall be firestopped using approved methods to maintain the fire resistance rating.
- S. Provide sleeves for conduits passing through foundation or other load bearing walls.
- T. Conduits installed underground which extend through the foundation walls shall be sealed to prevent the entrance of moisture through the foundation walls. All conduits extending through the exterior walls of a building in areas below grade shall be provided with a hydrostatic seal such as Link Seal or equal.
- U. Concealed Conduits:
  - 1. Conduits in finished areas shall be installed concealed.
- V. Install conduits as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or side walls.

W. Exposed Conduits:

1. In unfinished areas such as Janitor Closets, Storage, Mechanical Equipment Rooms, etc., conduit may be run exposed. Prior permission shall be first obtained from the Contracting Officer. All exposed conduit shall be installed in a neat manner following the building lines. Horizontal runs shall be close to the ceiling and shall be installed above mechanical piping as much as possible. Single hung conduits shall be supported with strap or rod hangers, wire is not an acceptable hanger. Multiple hung conduits shall be strapped to the channel to hold it in place.
2. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with or at right angles to walls of building.
3. Install exposed conduit work as not to interfere with ceiling inserts, lights or ventilation ducts or outlets.
4. Support exposed conduits by use of hangers, clamps or clips. Support conduits on each side of bends and on spacing not to exceed following: Up to 1-inch: 6-feet-0-inch; 1-1/4-inch and over: 8-feet-0-inch.
5. Above requirements for exposed conduits also apply to conduits installed in space above hung ceilings, and in crawl spaces except that spacing of supports for conduits up to 1-inch shall not exceed 8-feet-0-inch.

X. Conduit Fittings:

1. Construct locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.
2. Plastic insulating bushings for terminating rigid conduits smaller than 1-1/4-inch are to have ribbed sides, with smooth upper edges to prevent injury to cable insulation.
3. Install metallic insulated type bushings for terminating rigid conduits 1-1/4-inch and larger. Bushings are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing.
4. Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings and plugs to be specifically designed for their particular application.

3.3 INSTALLATION OF SURFACE RACEWAYS AND WIREWAYS

A. General: Mechanically assemble metal enclosures, and raceways for conductors to form continuous electrical conductor, and connect to electrical boxes, fittings and cabinets as to provide effective electrical continuity and rigid mechanical assembly.

1. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
2. Install expansion fittings in all raceways wherever structural expansion joints are crossed.
3. Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. No field bends of two-piece type raceway sections will be permitted.

4. Field bends of single piece raceway shall be permitted for small offsets only where the use of fittings supplied by the manufacturer is not possible. Field-bend raceway with benders designed for purpose so as not to distort nor vary internal diameter of raceway. Raceway shall be installed so as to avoid field bends wherever possible.
5. Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported.
6. Use boxes as supplied by raceway manufacturer wherever junction, pull or device boxes are required. Standard electrical "handy" boxes, etc. shall not be permitted for use with surface raceway installations.

END OF SECTION